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PATENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C. 20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 12 October 2000 (12.10.00)	
International application No. PCT/GB00/00430	Applicant's or agent's file reference P23357/JDB
International filing date (day/month/year) 11 February 2000 (11.02.00)	Priority date (day/month/year) 12 February 1999 (12.02.99)
Applicant WHYTE, Ronald et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
07 September 2000 (07.09.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer S. Mafla Telephone No.: (41-22) 338.83.38
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PATENT COOPERATION TREATY

PCT
PTO/PCT Rec'd 13 AUG 2001

NOTIFICATION OF THE RECORDING
OF A CHANGE

(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

MURGITROYD
& COMPANY

MURGITROYD & COMPANY
373 Scotland Street 7 MAY 2001
Glasgow G5 8QA
ROYAUME UNY

Date of mailing (day/month/year) 08 May 2001 (08.05.01)	IMPORTANT NOTIFICATION
Applicant's or agent's file reference P23357/JDB	
International application No. PCT/GB00/00430	International filing date (day/month/year) 11 February 2000 (11.02.00)

1. The following indications appeared on record concerning:

☒ the applicant ☒ the inventor ☐ the agent ☐ the common representative

Name and Address

McLAUCHLIN, Thomas, Kilpatrick
3 Keir Rise
Balmedie
Aberdeenshire AB23 8TW
United Kingdom

State of Nationality

GB

State of Residence

GB

Telephone No.

Facsimile No.

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☒ the name ☐ the address ☐ the nationality ☐ the residence

Name and Address

McLAUGHLIN, Thomas, Kilpatrick
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Balmedie
Aberdeenshire AB23 8TW
United Kingdom

State of Nationality

GB

State of Residence

GB

Telephone No.

Facsimile No.

Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

☒ the receiving Office ☐ the designated Offices concerned
☐ the International Searching Authority ☒ the elected Offices concerned
☒ the International Preliminary Examining Authority ☐ other:

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Authorized officer

Dominique DEUMAS

Facsimile No.: (41-22) 740.14.35

Telephone No.: (41-22) 338.83.38

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
17 August 2000 (17.08.2000)

PCT

(10) International Publication Number
WO 00/47927 A3

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41/02

(21) International Application Number: PCT/GB00/00430

(22) International Filing Date: 11 February 2000 (11.02.2000)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
9903150.2 12 February 1999 (12.02.1999) GB

(71) Applicants (for all designated States except US):
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Thomas, Kilpatrick [GB/GB]; 3 Keir Rise, Balmedie,
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(74) Agent: **MURGITROYD & COMPANY**; 373 Scotland
Street, Glasgow G5 8QA (GB).

(81) Designated States (national): AE, AL, AM, AT, AU, AZ,
BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK,
DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL,
IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU,
LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT,
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UG, US, UZ, VN, YU, ZA, ZW.

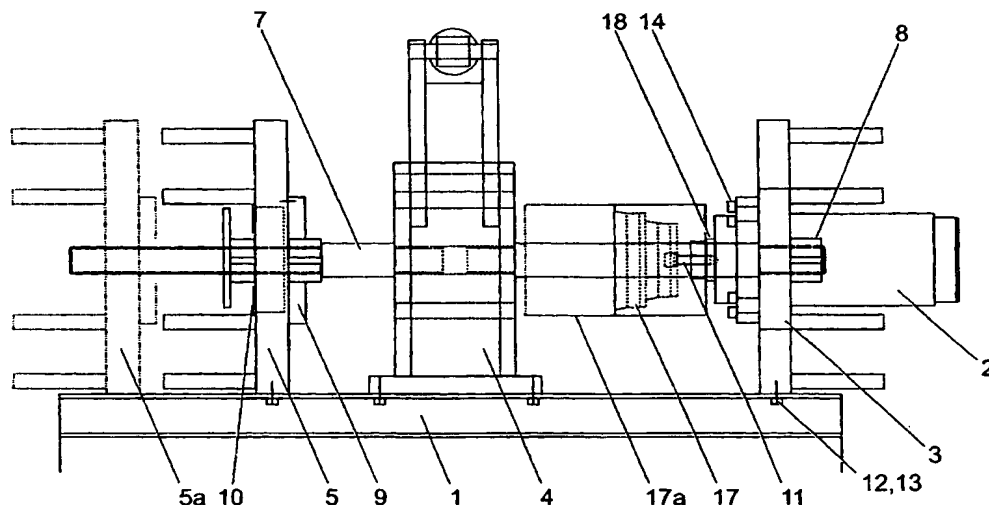
(84) Designated States (regional): ARIPO patent (GH, GM,
KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent
(AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent
(AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU,
MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM,
GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published:

— With international search report.

[Continued on next page]

(54) Title: APPARATUS FOR SWAGING AN OBJECT



(57) Abstract: An apparatus for swaging an end of a tubular (22) is described as comprising a swaging head (17) for providing the swage to the end of the tubular (22). The swaging head (17) has two or more swaging formations (22A, 22B) provided thereon to permit swaging of differing diameters of tubular ends. The apparatus may comprise a stop plate (5, 9) for abutment against the other end of the tubular (22), where the swaging head (17) and the stop plate (5, 9) are movably coupled to one another. The apparatus may have a clamping device (4) for clamping the tubular (22), where the clamping device is split into at least three part-circular clamping segments (30) which clamp around the outer circumference of the tubular to permit it to be swaged. The clamping device (4) may have a plurality of teeth (35) for gripping the outer surface of the tubular (22), and a plurality of grooves (36) formed between the teeth (35). The gripping surface of each tooth (35) is substantially parallel to the longitudinal axis of the tubular (2) to be gripped.

WO 00/47927 A3

WO 00/47927 A3



(88) Date of publication of the international search report:
5 April 2001

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

14

Applicant's or agent's file reference P23357A/MGO/JDB/JAL	FOR FURTHER ACTION		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/GB00/00430	International filing date (day/month/year) 11/02/2000	Priority date (day/month/year) 12/02/1999	
International Patent Classification (IPC) or national classification and IPC F16L55/00			
Applicant SCHOOLHILL HYDRAULIC ENGINEERING COMPANY LTD et al			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.



2. This REPORT consists of a total of 6 sheets, including this cover sheet.

- ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

Date of submission of the demand 07/09/2000	Date of completion of this report 04.05.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Rohr, P Telephone No. +49 89 2399 2098 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/00430

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-18 as originally filed

Claims, No.:

1-44 as originally filed

Drawings, sheets:

1/15-15/15 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/00430

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 20-44.

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion could be formed.

☒ no international search report has been established for the said claims Nos. 20-44.

2. A meaningful international preliminary examination cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

☐ the written form has not been furnished or does not comply with the standard.

☐ the computer readable form has not been furnished or does not comply with the standard.

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

☐ restricted the claims.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB00/00430

- ☐ paid additional fees.
- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.
- 2. ☒ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.
- 3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is
 - ☐ complied with.
 - ☐ not complied with for the following reasons:
- 4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:
 - ☐ all parts.
 - ☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims 2-19
	No: Claims 1
Inventive step (IS)	Yes: Claims
	No: Claims 2-19
Industrial applicability (IA)	Yes: Claims 1-19
	No: Claims

2. Citations and explanations see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB00/00430

see separate sheet

Re Item V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. US-A-3164045 discloses an apparatus (10) for swaging an end of a tubular (62), the apparatus (10) comprising a swaging head for providing the swage to the end of the tubular (62), wherein the swaging head has top or more swaging formations (22, 24, 26) provided thereon to permit swaging of differing diameters of tubular ends (62) The subject matter of claim 1 lacks novelty. Claim 1 does not meet the requirements of art. 33(2) PCT.
2. The additional features of the characterising portion of claim 2 do seemingly not involve an inventive step as depending from the intended direction of change of diameter the skilled person will determine the swaging formations either on the inner or outer side of the tool. This claim does not meet the requirements of Art. 33 (3) PCT.
3. The additional features of the characterising portion of claims 3-19 relate to shapes of different portions of the swaging tool which per se come within the customary practice of a skilled person designing a swaging tool for tubular goods. These claims do seemingly not meet the requirements of Art. 33 (3) PCT.

Re Item VII

Certain defects in the international application

1. The application is not restricted to the scope of claims 1 -19.
2. Closest prior art is not referenced and briefly discussed. The opening pages are not in line with Rule 5.1 (a) (ii) PCT.

Re Item VIII

Certain observations on the international application

1. The claims are not in line with Rule 6.2 (b) PCT.

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/00430

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B21D41/04 B21D41/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B21C B21J B21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 380 285 A (WILSON FRANK R) 30 April 1968 (1968-04-30) column 1, line 66 - column 2, line 16; figures 1,2 ---	1,11
X	US 3 164 045 A (M. L. KENNEDY) 5 January 1965 (1965-01-05) claims A-F; figures 2,6,7 ---	1,11
X	US 1 898 586 A (J. MAZER) 21 February 1933 (1933-02-21) column 1, line 1 - line 12; figure 1 ---	1,2
A	WO 95 10000 A (WIRSB0 BRUKS AB ;SOERBERG BENGT (SE)) 13 April 1995 (1995-04-13) page 5, line 10 - line 20; figure 1 --- -/--	12



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"Z" document member of the same patent family

Date of the actual completion of the international search

27 June 2000

Date of mailing of the international search report

04 01. 2001

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Marc Augé

INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 00/00430

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 730 633 C (E. HEINKEL FLUGZEUGWERKE) 15 January 1943 (1943-01-15) page 1, line 39 - line 44; figures 2,3 ---	3
A	US 4 088 008 A (WATLING LEIGHTON HARVEY ET AL) 9 May 1978 (1978-05-09) column 1, line 29 - line 36; figures 1,2 -----	1,20,30, 41,44

INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 00/00430

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-19

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-19

Swaging head having two or more swaging formations

2. Claims: 20-29

Stop plate movably coupled to swaging head

3. Claims: 30-40

Clamping device split into at least three part-circular clamping segments

4. Claims: 41-43, 44

Clamping device having a plurality of teeth

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

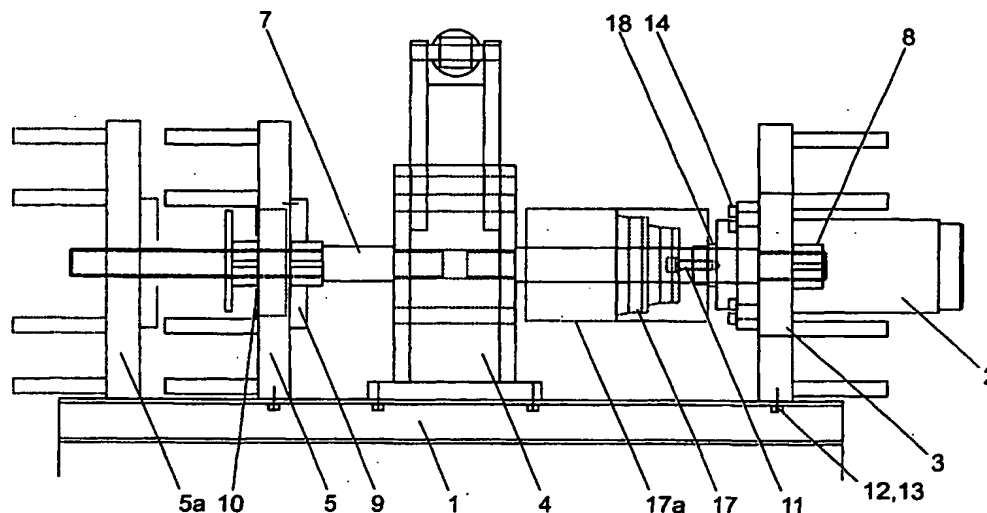
PCT/GB 00/00430

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3380285 A	30-04-1968	NONE	
US 3164045 A	05-01-1965	NONE	
US 1898586 A	21-02-1933	NONE	
WO 9510000 A	13-04-1995	SE 501555 C AT 173531 T AU 7867294 A BR 9407753 A CA 2173256 A CN 1132545 A,B CZ 9600960 A DE 69414721 D DE 69414721 T DK 725908 T EP 0725908 A ES 2124918 T FI 962793 A HU 74530 A NO 961330 A PL 313785 A RU 2120343 C SE 9303295 A US 5744085 A	13-03-1995 15-12-1998 01-05-1995 04-03-1997 13-04-1995 02-10-1996 11-09-1996 24-12-1998 06-05-1999 02-08-1999 14-08-1996 16-02-1999 09-07-1996 28-01-1997 01-04-1996 22-07-1996 20-10-1998 13-03-1995 28-04-1998
DE 730633 C		NONE	
US 4088008 A	09-05-1978	NONE	

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : F16L 55/00		A2	(11) International Publication Number: WO 00/47927
			(43) International Publication Date: 17 August 2000 (17.08.00)
(21) International Application Number: PCT/GB00/00430 (22) International Filing Date: 11 February 2000 (11.02.00) (30) Priority Data: 9903150.2 12 February 1999 (12.02.99) GB (71) Applicants (for all designated States except US): SCHOOL- HILL HYDRAULIC ENGINEERING COMPANY LIM- ITED [GB/GB]; 4 Greenbank Place, East Tullis, Aberdeen AB12 3RJ (GB). MAXTUBE LIMITED [GB/GB]; Hare- ness Road, Altens, Aberdeen AB12 3LE (GB). (72) Inventors; and (75) Inventors/Applicants (for US only): WHYTE, Ronald [GB/GB]; 2 West Cults Road, Cults, Aberdeen AB15 9HN (GB). MUDGE, Joseph, Krist [US/GB]; 22 Cults Avenue, Aberdeen AB15 9RS (GB). McLAUCHLIN, Thomas, Kilpatrick [GB/GB]; 3 Keir Rise, Balmedie, Aberdeenshire AB23 8TW (GB). (74) Agent: MURGITROYD & COMPANY; 373 Scotland Street, Glasgow G5 8QA (GB).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published Without international search report and to be republished upon receipt of that report.	

(54) Title: APPARATUS FOR SWAGING AN OBJECT



(57) Abstract

An apparatus for swaging an end of a tubular is described as comprising a swaging head for providing the swage to the end of the tubular. The swaging head has two or more swaging formations provided thereon to permit swaging of differing diameters of tubular ends. The apparatus may comprise a stop plate for abutment against the other end of the tubular, where the swaging head and the stop plate are movably coupled to one another. The apparatus may have a clamping device for clamping the tubular, where the clamping device is split into at least three part-circular clamping segments which clamp around the outer circumference of the tubular to permit it to be swaged. The clamping device may have a plurality of teeth for gripping the outer surface of the tubular, and a plurality of grooves formed between the teeth. The gripping surface of each tooth is substantially parallel to the longitudinal axis of the tubular to be gripped.

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Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

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CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

1 "Apparatus for Swaging an Object"

2

3 The present invention relates to an apparatus for
4 swaging an object, and particularly relates to an
5 apparatus for swaging an end of a tubular member, such
6 as a length of casing or drillpipe used in the oil and
7 gas industry.

8

9 Conventionally, casing tubulars have a standard pin
10 type connector at each end, and one end of a casing
11 tubular is connected to an end of another casing
12 tubular by means of a casing joint, commonly known as a
13 coupler, and which comprises a short length of tube
14 having a standard box type connector at each end.
15 Alternatively, tubulars, such as drill pipe in
16 particular, have a standard pin type connection at one
17 end and a standard box type connection at the other
18 end.

19

20 It is important that a made up tubular string, such as
21 a casing, lining or drill string has a substantially
22 linear throughbore at the joints between the respective
23 tubulars, and couplers if present.

24

25 The pin and/or box connections are conventionally made

1 up on a tubular by first swaging respectively inwardly
2 or outwardly the outer diameter of the ends of the pipe
3 by a suitable amount so that pins can be formed. This
4 swaging of the outer diameter of the pipe necessarily
5 respectively reduces or increases the internal diameter
6 of the pipe end.

7
8 After the end of the pipe has been swaged, the internal
9 or external diameter of the end of the pipe is then
10 machined. The swaging process ensures that there is
11 material around the entire circumference of the
12 internal or external diameter of the pipe that can be
13 machined away, thereby achieving concentricity of the
14 internal or external diameter of the pipe end.
15 Additionally, this ensures that there are no thick or
16 thin sections of wall thickness on the pipe end,
17 thereby ensuring a constant wall thickness to the pipe
18 end.

19
20 Thereafter, the screw thread of the pipe end can be
21 formed on its outer or inner circumference.

22
23 A conventional machine for swaging an end of a pipe
24 comprises a swaging head having a single swaging
25 formation thereon for swaging a particular diameter of
26 pipe. The pipe to be swaged is held between a semi-
27 circular lower clamp and two upper quarter circular
28 segments, where the two upper segments are hinged to
29 the lower semi-circular clamp to permit the pipe to be
30 inserted into the clamp. The clamp is provided with
31 plurality of teeth, in a saw tooth arrangement, to grip
32 the pipe. However, with the saw tooth arrangement, the
33 teeth tend to bite into and damage the outer wall of
34 the pipe. Furthermore, where the pipe has slight
35 variations in the outer circumference of its wall, the
36 teeth will tend to grip certain parts of the outer

1 diameter more forcefully than other parts, since the
2 clamping device is substantially immovable once it has
3 been closed.

4
5 According to a first aspect of the present invention,
6 there is provided an apparatus for swaging an end of a
7 tubular, the apparatus comprising a swaging head for
8 providing the swage to the end of the tubular, wherein
9 the swaging head has two or more swaging formations
10 provided thereon to permit swaging of differing
11 diameters of tubular ends.

12
13 The swaging formation may be provided on an internal
14 bore of the swaging head, such that the internal bore
15 of the swaging head engages the outer diameter of the
16 tubular end to provide the swage thereto.

17
18 Each swaging formation may comprise a first diameter of
19 the swaging head, a second diameter being smaller than
20 the first diameter, a third diameter being smaller than
21 the second diameter, and a fourth diameter being
22 smaller than the third diameter. Preferably, the
23 internal bore of the swaging head tapers substantially
24 linearly inwardly, with respect to the longitudinal
25 axis of the swaging head, from the first diameter to
26 the second diameter, and from the second diameter to
27 the third diameter. Typically, the angle of the taper
28 from the first to the second diameter is greater than
29 the angle of the taper from the second to third
30 diameter. Typically, the surface of the internal bore
31 of the swaging head provided by the taper from the
32 first to the second diameter is a guiding surface, and
33 the surface provided by the taper from the second to
34 third diameter is a swaging surface.

35
36 The surface of the internal bore of the swaging head

1 from the second/third diameter to the third/fourth
2 diameter may be arranged to be substantially
3 perpendicular to the longitudinal axis of the swaging
4 head, and is preferably arranged to provide a shoulder
5 or a stop surface against which the tubular end
6 arrests.

7
8 Preferably, the swaging head is arranged with at least
9 first and second swaging formations, whereby the fourth
10 diameter of the first swaging formation is greater than
11 the first diameter of the second swaging formation.
12 Typically, the first diameter of the first swaging
13 formation is the closest diameter of all of the
14 diameters of all of the swaging formations to the
15 tubular end, in use.

16
17 Alternatively, the swaging formation may be provided on
18 an external diameter of the swaging head, such that the
19 external diameter of the swaging head engages the inner
20 diameter of the tubular end to provide the swage
21 thereto.

22
23 Each swaging formation may comprise a first diameter of
24 the swaging head, a second diameter being greater than
25 the first diameter, a third diameter being greater than
26 the second diameter, and a fourth diameter being
27 greater than the third diameter. Preferably, the
28 external diameter of the swaging head tapers
29 substantially linearly outwardly, with respect to the
30 longitudinal axis of the swaging head, from the first
31 diameter to the second diameter, and from the second
32 diameter to the third diameter. Typically, the angle
33 of the taper from the first to the second diameter is
34 greater than the angle of the taper from the second to
35 third diameter. Typically, the surface of the external
36 diameter of the swaging head provided by the taper from

1 the first to the second diameter is a guiding surface,
2 and the surface provided by the taper from the second
3 to third diameter is a swaging surface.

4
5 The surface of the external diameter of the swaging
6 head from the second/third diameter to the third/fourth
7 diameter may be arranged to be substantially
8 perpendicular to the longitudinal axis of the swaging
9 head, and is preferably arranged to provide a shoulder
10 or a stop surface against which the tubular end
11 arrests.

12
13 Preferably, the swaging head is arranged with at least
14 first and second swaging formations, whereby the fourth
15 diameter of the first swaging formation is smaller than
16 the first diameter of the second swaging formation.
17 Typically, the first diameter of the first swaging
18 formation is the closest diameter of all of the
19 diameters of all of the swaging formations to the
20 tubular end, in use.

21
22 Two or more swaging formations may be provided.

23
24 According to a second aspect of the present invention,
25 there is provided an apparatus for swaging an end of a
26 tubular, the apparatus comprising a swaging head for
27 swaging the end of the tubular, and a stop plate for
28 abutment against the other end of the tubular, the
29 swaging head and the stop plate being movably coupled
30 to one another.

31
32 Movement of the swaging head and the stop plate toward
33 one another typically facilitates swaging of the said
34 one end of the tubular.

35
36 Typically, the swaging head is moveable toward the stop

1 plate by means of a piston, and preferably, the swaging
2 head and the stop plate are movably coupled to one
3 another by a frame. Typically, the frame is adjustable
4 such that distance between the stop plate and the
5 swaging head can be further varied by adjustment of the
6 frame.

7
8 Typically, the frame comprising at least one member
9 coupled to both of the swaging head and the stop plate,
10 and preferably the coupling between the member and at
11 least one of the stop plate and swaging head can be
12 adjusted in order to vary the length of the member
13 between the swaging head and the stop plate.
14 Preferably, the coupling between the member and the
15 stop plate is in the form of a screw thread engagement.

16
17 Preferably, the stop plate comprises a bore and a
18 device for obturating the bore, such that when the
19 device obturates the bore, the device abuts the said
20 other end of the tubular. Typically, the device is
21 removable from the stop plate such that a tubular to be
22 swaged may be passed through the bore. This provides
23 the invention with the advantage that the device can be
24 inserted into or over the bore so that short lengths of
25 tubular can be swaged, and the device can be removed
26 from the stop plate so that longer lengths of tubular
27 can be swaged.

28
29 According to a third aspect of the present invention
30 provides an apparatus for swaging an end of a tubular,
31 the apparatus comprising a swaging head for swaging the
32 end of the tubular, and a clamping device for clamping
33 the tubular, the clamping device being split into at
34 least three part-circular clamping segments which clamp
35 substantially around the outer circumference of the
36 tubular to permit it to be swaged.

1 Preferably, there are at least four part-circular
2 clamping segments which clamp substantially around the
3 outer circumference of the tubular to permit it to be
4 swaged.

5
6 Preferably, there are two clamping devices provided,
7 typically a forward clamping device which is arranged
8 to be closest to the swaging head, and a rear clamping
9 device which is arranged to be furthest from the
10 swaging head.

11
12 Typically, the clamping segments are housed within a
13 clamping ring, and may be mounted on the clamping ring
14 in an arrangement such that the segments can move,
15 preferably only to a relatively small degree, with
16 respect to the ring.

17
18 Preferably, the clamping ring is split into at least
19 two part circular members, where the members may be
20 hinged together, such that the ring may be opened to
21 permit a tubular to be inserted into the ring, and
22 closed to clamp the segments around the tubular.

23
24 Typically, a range of segments can be housed within the
25 ring, where the range of segments may be of varying
26 radial thickness, to permit a range of differing
27 diameter tubulars to be clamped.

28
29 According to a fourth aspect, the present invention
30 provides an apparatus for swaging a tubular, the
31 apparatus comprising a swaging head for swaging the end
32 of the tubular, and a clamping device for clamping the
33 tubular, the clamping device having a plurality of
34 teeth for gripping the outer surface of the tubular,
35 and a plurality of grooves formed between the teeth,
36 wherein the gripping surface of each tooth is

1 substantially parallel to the longitudinal axis of the
2 tubular to be gripped.

3

4 This provides the invention with the advantage that the
5 teeth do not bite into the outer surface of the
6 tubular, thus avoiding damaging the tubular.

7

8 The grooves may be formed with two side walls which are
9 substantially perpendicular to the longitudinal axis of
10 the tubular to be gripped, and may be formed with a
11 lowermost surface which is substantially parallel to
12 the longitudinal axis of the tubular to be gripped.

13

14 An embodiment of the present invention will now be
15 described, by way of example only, with reference to
16 the accompanying drawings, in which:-

17

18 Fig. 1 is a side view of an apparatus for swaging
19 an end of a tubular in accordance with the present
20 invention;

21 Fig. 2 is a plan view of the apparatus of Fig. 1;

22 Fig. 3 is an end view of the apparatus of Fig. 1;

23 Fig. 4 is an end view of the clamping device of
24 the apparatus of Fig. 1;

25 Fig. 5 is a plan view of the clamping device of
26 Fig. 4;

27 Fig. 6 is a cross-sectional view of a first
28 swaging head for use of the apparatus of Fig. 1;

29 Fig. 7 is a second swaging head for use with the
30 apparatus of Fig. 1;

31 Fig. 8 is a third swaging head for use with the
32 apparatus of Fig. 1;

33 Fig. 9 is a fourth swaging head for use with the
34 apparatus of Fig. 1;

35 Fig. 10 is a series of part cross-sectional side
36 views of gripping devices for use with the

1 clamping device of Fig. 4;
2 Fig. 11 is an end view of one of the sets of
3 gripping devices of Fig. 10;
4 Fig. 12 is a part cross-sectional side view of the
5 set of gripping devices of Fig. 11;
6 Fig. 13 is a detailed cross-sectional view of a
7 portion of the gripping device of Fig. 12;
8 Fig. 14 is a side view of a first male swaging
9 head for use of the apparatus of Fig. 1;
10 Fig. 15 is a second male swaging head for use with
11 the apparatus of Fig. 1;
12 Fig. 16 is a third male swaging head for use with
13 the apparatus of Fig. 1; and
14 Fig. 17 is a fourth male swaging head for use with
15 the apparatus of Fig. 1.

16
17 Fig. 1 shows an apparatus for swaging the end of a
18 tubular or a pipe such as a length of casing or
19 drillpipe used in the oil and gas industry.

20
21 The apparatus comprises a base frame 1 which, in use of
22 the apparatus, would typically lie on a workshop floor.
23 A press head 3 is mounted on the base frame 1 by means
24 of a cap screw 12 and taper washer 13, such that the
25 press head 3 stands vertically upright from the
26 horizontally arranged base frame 1. A swaging cylinder
27 2 is mounted on the press head 3 by means of a
28 plurality of cap screws 14, such that the longitudinal
29 axis of the swaging cylinder 2 is arranged to be
30 substantially horizontal. A piston rod 18 is located
31 within the swaging cylinder 2, such that the piston rod
32 18 lies on the longitudinal axis of the swaging
33 cylinder 2. The furthest end of the piston rod 18 is
34 typically coupled to a swaging or die head 17 by means
35 of a cap screw 11, such that actuation of the swaging
36 cylinder 2 moves the piston rod 18, and hence die head

1 17 outwardly from the swaging cylinder 2, until the
2 piston rod 18 has potentially travelled its maximum
3 stroke or contact is made with the stop shoulder, which
4 is indicated in Fig. 1 by the die heads 17 reaching its
5 position which is shown in phantom 17A. As shown in
6 Fig. 1, it is preferred that the maximum stroke of the
7 piston rod 18, and hence die head 17, is twelve inches.

8
9
10 A clamping unit 4 is mounted on the base frame 1 at
11 approximately the mid-point of the base frame 1, such
12 that the clamping unit stands vertically upright with
13 respect to the base frame 1. The clamping unit 4 will
14 be described in more detail subsequently.

15
16 An end stop 5 is movably mounted upon the base frame 1,
17 such that the end stop 5 stands vertically upright with
18 respect to the base frame 1.

19
20 A first pair of struts or strengthening members in the
21 form of tie rods 6 are provided between the press head
22 3 and the clamping unit 4, and are arranged to lie on
23 the plane of the longitudinal axis of the swaging
24 cylinder 2, on either side of the die head 17. The tie
25 rods 6 are secured to the press head 3 by means of nuts
26 8, and are screw threaded to the clamping unit 4. A
27 second pair of struts or strengthening members in the
28 form of tie rods 7 act between the clamping unit 4 and
29 the end stop 5, and are arranged to lie on the plane of
30 the longitudinal axis of the swaging cylinder 2. The
31 tie rods 7 are secured to the clamping unit 4 by means
32 of screw threads, and are secured to the end stop 5 by
33 means of a nut 19 on one side of the end stop 5, and a
34 hand wheel nut 15 on the other side of the end stop 5.
35 It should be noted that the majority of the outer
36 surface of the tie rods 7 is provided with a screw

1 thread formation thereon, such that an operator of the
2 apparatus can rotate the hand wheel nut 15 to permit
3 the end stop 5 to be moved along the tie rods 7 from
4 the position of the end stop 5 shown in Fig. 1 to the
5 position of the end stop 5A shown in phantom in Figs. 1
6 and 2. Thus, the distance between the end stop 5 and
7 the die head 17 can be varied.

8
9 As shown in Fig. 2, the end stop 5 is provided with a
10 bore 20, which can be obturated by placing a push plate
11 9 on the end stop 5, and attaching the push plate 9 by
12 means of a stud 13, nuts 16 and a retaining plate 21.

13
14 Accordingly, the push plate 9 can be placed on the end
15 stop 5, as shown in Figs. 1 and 2, and the end stop 5
16 can be positioned so that the push plate 9 butts
17 against an end of a relatively short length of pipe,
18 such as a pup joint 22 used in the oil and gas
19 industry. The middle of the pup joint 22 can be
20 supported by the clamping unit 4, and the swaging
21 cylinder 2 can be operated to move the die head 17
22 toward the closest end of the pup joint 22 to it, such
23 that the die head 17 swages the end of the pup joint
24 22.

25
26 As shown in Fig. 4, the clamping unit 4 comprises a
27 clamp base 41, and a pair of clamp arms 42, 43 which
28 are respectively hingedly coupled to the clamp base 41
29 by means of pivot pins 44, washers 51 and split pins 52
30 at the lowest ends of the respective clamp arms 42, 43.
31 The upper ends of the clamp arms 42, 43 can be
32 releasably coupled together by means of a cylinder 45
33 which is attached to one of the clamp arms 43 by means
34 of a trunnion bearing half 46 and a socket head cap
35 screw 47. A trunnion pin 48 is mounted on the other
36 clamp arm 42 by means of a washer 49 and split pin 50,

1 and the trunnion pin 48 is engageable with the trunnion
2 bearing half 46, such that operation of the cylinder 45
3 pulls the clamp arms 42, 43 toward one another.
4 However, it should be noted that the connection between
5 the arms 42, 43 can be varied so as to make them
6 interchangeable, for ease of production.

7
8 Thus, the clamp arms 42A, 43A are moveable from their
9 open position shown in phantom on Fig. 4 in which a
10 pipe (not shown) can be inserted into the clamp unit 4,
11 to a closed position 42, 43 in which the clamping arms
12 42, 43 substantially surround a section of the outer
13 circumference of the tubular.

14
15 A first example of a "female" die head 17A is shown in
16 Fig. 6, where this die head 17A is suitable for swaging
17 two different pipe sizes, these being a relatively
18 large pipe size of $13\frac{3}{8}$ inches outer diameter, and a
19 smaller pipe having an outer diameter of $10\frac{3}{4}$ inch.
20 However, it should be noted that the specific
21 dimensions of the diehead can be varied for different
22 swaging requirements.

23
24 This example of the die head 17A has a first swaging
25 formation, generally designated as 22A, and is formed
26 on the internal bore of the die head 17A. This first
27 swaging formation 22A has a first diameter 23A formed
28 at the mouth of the internal bore of the die head 17A.
29 A second diameter 24A is shown as being to the right of
30 the first diameter 23a in Fig. 6, where the second
31 diameter 24A is slightly smaller than the first
32 diameter 23A (13.86 inches). The surface of the
33 internal bore tapers linearly inwards from the first
34 23A to the second 24A diameters at an angle of 9° to
35 the longitudinal axis of the die head 17, and forms a
36 lead-in surface 25A to guide the pipe end into the

1 internal bore of the die head 17. A third diameter 26A
2 is shown in Fig. 6 as being to the right of the second
3 diameter 24A, where the third diameter 26A is smaller
4 (13.24 inches) than the second diameter 24A. The
5 surface of the internal bore tapers linearly inwardly
6 from the second 24A to the third 26A diameters at an
7 angle of 3° to the longitudinal axis of the die head
8 17, where the surface between the second 24A and third
9 26A diameters forms a swaging surface 27A to provide a
10 swage to the 13³/₈ inch pipe end. A shoulder 28A
11 projects radially inwardly at an angle perpendicular to
12 the longitudinal axis of the die head 17 and provides a
13 stop surface thereon to ensure that the die heads 17
14 cannot "overswage" the pipe end.

15
16 A second swaging formation 22B is also provided on the
17 internal bore of the die heads 17, and is shown in Fig.
18 6 as being to the right of the first swaging formation
19 22A. The various diameters 23B, 24B, 26B of the second
20 swaging formation 22B are all smaller than the
21 respective diameters 23A, 24A, 26A of the first swaging
22 formation 22A, and are of a size suitable for providing
23 a swage to a 10³/₄ inch pipe.

24
25 Fig. 7 shows a second example of a die head 17B, and
26 which has a first swaging formation 22C, which is
27 similar to the first swaging formation 22A of the die
28 head 17A, and a similar second swaging formation 22D.
29 The swaging formations 22C, 22D are sized to provide a
30 swage to respective pipe sizes 9⁵/₈ inch and 7⁵/₈ inch.

31
32 Fig. 8 shows a third example of the die head 17C, where
33 this die head 17C has three swaging formations 22E,
34 22F, 22G provided thereon to enable the die head 17C to
35 provide a swage to three different pipe sizes, these
36 being respectively 7 inch, 5¹/₂ inch and 4¹/₂ inch.

Fig. 9 shows a fourth example of a die head 17D, also having three swaging formations 22H, 22I, 22J provided thereon to enable the die head 17D to provide a swage to three different pipe sizes, these being respectively $6\frac{5}{8}$ inch, 5 inch and 4 inch pipe diameters.

An operator of the apparatus can choose the correct die head 17A, B, C, D as required by the diameter of the pipe, and can attach the correct die head 17A, B, C, D by means of the cap screw 11.

It will also be appreciated by those skilled in the art that a die head having one or more swaging formations formed on it's outer circumference for providing a swage to the inner bore of an end of a tubular can also be provided for use with the apparatus, and such a range of "male" dieheads is shown in Figs. 14 to 17. The one or more swaging formations on the outer circumference are, in essence, mirror images of the swaging formations hereinbefore described in detail.

Figs. 11 and 12 show one set of clamping segments or collets 30A, B, C, D where each clamping collet 30 circumscribes an angle of preferably slightly less than 90° of a circle. However, it should be noted that two sets of clamping collets 30, 32 are utilised in the apparatus, as will now be described. As shown in Fig. 10, a forward set 30 of collets is mounted to the clamping unit 4, where this first set 30 is arranged to be closest to the die head 17, and a rear set 32 of clamping collets is also mounted to the clamping unit 4. The two lower clamping collets 30B, 30C are mounted to the lower semi-circular bore of the clamp base 41, and one of the upper clamping collets 30A, 30B are mounted to the respective clamp arms 42, 43, where each clamping collet 30A, B, C, D is mounted to the clamping

1 units by means of a fixing screw 33 which passes
2 through a first aperture 34 in the respective clamping
3 collet 30A, B, C, D. Thus, since there is only one
4 fixing screw 33 per clamping collet, the clamping
5 collets 30 can move slightly with respect to the
6 clamping unit 4, and this provides the apparatus with
7 the advantage that the clamping collets can move to
8 compensate for slight irregularities in the outer
9 circumference of the pipe to be swaged.

10

11 However, the two lower clamping collets 30B, 30C may be
12 modified to be combined into one lower clamping collet
13 (not shown) which would preferably circumscribe an
14 angle of slightly less than 180° of a circle. This
15 modified lower clamping collet is also preferably
16 mounted on the clamping unit in a suitable arrangement
17 such that it can move slightly with respect to the
18 clamping unit 4.

19

20 The inner bore of the clamping collets 30 is provided
21 with a clamping formation thereon, as shown in Fig. 13.
22 The clamping formation comprises a plurality of flat
23 teeth 35 which are of equal width. The upper surface
24 of the flat teeth 35 are parallel with the longitudinal
25 axis of the pipe to be swaged, and the flat teeth 35
26 are spaced apart by substantially flat troughs 36,
27 where the flat troughs 36 are of substantially equal
28 length with the flat teeth 35. In the clamping collets
29 30 shown in Fig. 13, there are six flat teeth 35 per
30 inch along the internal surface of the clamping collets
31 30. The presence of the flat troughs 36 provide the
32 advantage that corrosion or contamination appearing on
33 the outer surface of the pipe to be swaged can be
34 squeezed off by the flat teeth 35 and located within
35 the flat troughs 36, thus providing an enhanced
36 clamping action upon the pipe to be swaged.

1 Furthermore, the flat teeth 35 do not "bite" into the
2 outer surface of the pipe to be swaged.

3
4 As shown in Fig. 10, there are ten arrangements of sets
5 of clamping collets for clamping ten different
6 diameters of pipe, although there may be additional
7 sets provided for non-standard diameter pipes. The
8 first set, as shown in set (1), is for clamping around
9 the largest casing diameter normally used, this being
10 13.38 inches. Set (2) and set (3) are for clamping
11 10.75 inches and 9.63 inches diameter pipes
12 respectively, with clamping collets 56 and 57
13 respectively. The clamping collets 57 of set (3) can
14 be combined with different radius collet inserts 58A,
15 B, C, D, E, F, G by means of fixing screws 59 to permit
16 smaller diameter pipe sizes 7.62 inches, 7 inches, 6.62
17 inches, 5.5 inches, 5 inches, 4.5 inches and 4 inches
18 respectively to be clamped. Thus, by combining the
19 collet inserts 58A-G with the clamping collets 57, the
20 apparatus has the advantage of providing a flexible
21 arrangement for clamping and thereafter swaging a
22 variety of different diameter pipe sizes.

23
24 As stated before, the push plate 9 can be located on
25 the end stop 5 to permit short lengths of pipe such as
26 pup joints 22 to be swaged; clamping unit 4 is not used
27 in this case and the two lower clamping collets 30B,
28 30C support the pup joint 22 at its mid point. For
29 longer lengths of pipe, the push plate 9 is removed,
30 and the pipe end to be swaged is passed through the
31 bore 20 of the end stop 5, and the clamp arms 42, 43
32 are closed around the outer diameter of the pipe.

33
34 The die head 17 is typically pushed onto the end of the
35 pipe to be swaged, with typically 350 tonnes of push
36 being applied. With this amount of push being applied,

1 a shoulder 60 is provided on the clamping collets 30,
2 32, 56, 57, and a shoulder 62 is provided on the collet
3 inserts 58A-G, to ensure that the respective screws 33,
4 59 are not broken when the push is applied.

5
6 The hydraulic pressure requirements of the cylinder 2
7 are thus very high, and for many pipes, the piston push
8 provided by the cylinder 2, 45 will be too great.
9 Therefore, there is provided a safety control system,
10 on both the clamp unit 4 to ensure that the pipe is not
11 crushed, and also on the die head piston cylinder 2, to
12 ensure that overpressure is not applied when swaging.
13 An unloading valve is included in the hydraulic fluid
14 control circuit and is arranged to dump overpressure of
15 hydraulic fluid back into the hydraulic fluid
16 reservoir. The unloading valve is actuated by the
17 electronic circuit. Before swaging a pipe, the
18 operator of the apparatus looks up the characteristics
19 of the pipe in a manual provided with the apparatus,
20 where the characteristics are typically weight or wall
21 thickness, the grade of metal used in the pipe, and the
22 outside diameter of the pipe. The manual then informs
23 the operator what the safe pressure or load that the
24 operator can apply to both the clamp unit and the
25 swaging cylinder 2. The operator then inputs this safe
26 pressure or load into the electronic circuit which, if
27 this safe pressure or load is exceeded, the electronic
28 circuit then operates the unloading valve. Operation
29 of the unloading valve however retains the intended
30 safe working pressure or load. A visual indicator may
31 be used in addition, or in the alternative to the
32 electronic circuit, to indicate that the correct
33 pressure has been achieved.

34
35 Modifications and improvements may be incorporated into
36 the embodiment without departing from the scope of the

1 invention.

2

3

1 CLAIMS:-

2

3 1. An apparatus for swaging an end of a tubular, the
4 apparatus comprising a swaging head for providing the
5 swage to the end of the tubular, wherein the swaging
6 head has two or more swaging formations provided
7 thereon to permit swaging of differing diameters of
8 tubular ends.

9

10 2. An apparatus according to claim 1, wherein the
11 swaging formation is provided on an internal bore of
12 the swaging head, such that the internal bore of the
13 swaging head is capable of engaging the outer diameter
14 of the tubular end to provide the swage thereto.

15

16 3. An apparatus according to claim 2, wherein each
17 swaging formation comprises a first diameter of the
18 swaging head, a second diameter being smaller than the
19 first diameter, a third diameter being smaller than the
20 second diameter, and a fourth diameter being smaller
21 than the third diameter.

22

23 4. An apparatus according to claim 3, wherein the
24 internal bore of the swaging head tapers substantially
25 linearly inwardly, with respect to the longitudinal
26 axis of the swaging head, from the first diameter to
27 the second diameter, and from the second diameter to
28 the third diameter.

29

30 5. An apparatus according to claim 4, wherein the
31 angle of the taper from the first to the second
32 diameter is greater than the angle of the taper from
33 the second to third diameter.

34

35 6. An apparatus according to either of claims 4 or 5,
36 wherein the surface of the internal bore of the swaging

1 head provided by the taper from the first to the second
2 diameter is a guiding surface, and the surface provided
3 by the taper from the second to third diameter is a
4 swaging surface.

5
6 7. An apparatus according to any of claims 3 to 6,
7 wherein the surface of the internal bore of the swaging
8 head from the second/third diameter to the third/fourth
9 diameter is arranged to be substantially perpendicular
10 to the longitudinal axis of the swaging head.

11
12 8. An apparatus according to claim 7, wherein the
13 surface of the internal bore of the swaging head from
14 the second/third diameter is arranged to provide a
15 shoulder or a stop surface against which the tubular
16 end arrests, in use.

17
18 9. An apparatus according to any of claims 3 to 8,
19 wherein the swaging head is arranged with at least
20 first and second swaging formations, whereby the fourth
21 diameter of the first swaging formation is greater than
22 the first diameter of the second swaging formation.

23
24 10. An apparatus according to any of claims 3 to 9,
25 wherein the first diameter of the first swaging
26 formation is the closest diameter of all of the
27 diameters of all of the swaging formations to the
28 tubular end, in use.

29
30 11. An apparatus according to claim 1, wherein the
31 swaging formation is provided on an external diameter
32 of the swaging head, such that the external diameter of
33 the swaging head engages the inner diameter of the
34 tubular end to provide the swage thereto.

35
36 12. An apparatus according to claim 11, wherein each

1 swaging formation comprises a first diameter of the
2 swaging head, a second diameter being greater than the
3 first diameter, a third diameter being greater than the
4 second diameter, and a fourth diameter being greater
5 than the third diameter.

6
7 13. An apparatus according to claim 12, wherein the
8 external diameter of the swaging head tapers
9 substantially linearly outwardly, with respect to the
10 longitudinal axis of the swaging head, from the first
11 diameter to the second diameter, and from the second
12 diameter to the third diameter.

13
14 14. An apparatus according to claim 13, wherein the
15 angle of the taper from the first to the second
16 diameter is greater than the angle of the taper from
17 the second to third diameter.

18
19 15. An apparatus according to either of claims 13 or
20 14, wherein the surface of the external diameter of the
21 swaging head provided by the taper from the first to
22 the second diameter is a guiding surface, and the
23 surface provided by the taper from the second to third
24 diameter is a swaging surface.

25
26 16. An apparatus according to any of claims 12 to 15,
27 wherein the surface of the external diameter of the
28 swaging head from the second/third diameter to the
29 third/fourth diameter is arranged to be substantially
30 perpendicular to the longitudinal axis of the swaging
31 head.

32
33 17. An apparatus according to claim 16, wherein the
34 surface of the external diameter of the swaging head
35 from the second/third diameter to the third/fourth
36 diameter is arranged to provide a shoulder or a stop

1 surface against which the tubular end arrests, in use.

2

3 18. An apparatus according to any of claims 12 to 17,
4 wherein the swaging head is arranged with at least
5 first and second swaging formations, whereby the fourth
6 diameter of the first swaging formation is smaller than
7 the first diameter of the second swaging formation.

8

9 19. An apparatus cording to any of claims 12 to 18,
10 wherein the first diameter of the first swaging
11 formation is the closest diameter of all of the
12 diameters of all of the swaging formations to the
13 tubular end, in use.

14

15 20. An apparatus for swaging an end of a tubular, the
16 apparatus comprising a swaging head for swaging the end
17 of the tubular, and a stop plate for abutment against
18 the other end of the tubular, the swaging head and the
19 stop plate being movably coupled to one another.

20

21 21. An apparatus according to claim 20, wherein
22 movement of the swaging head and the stop plate toward
23 one another facilitates swaging of the said one end of
24 the tubular.

25

26 22. An apparatus according to either of claims 20 or
27 21, wherein the swaging head is moveable toward the
28 stop plate by means of a piston.

29

30 23. An apparatus according to any of claims 20 to 22,
31 wherein the swaging head and the stop plate are movably
32 coupled to one another by a frame.

33

34 24. An apparatus according to claim 23, wherein the
35 frame is adjustable such that the distance between the
36 stop plate and the swaging head can be further varied

1 by means of adjustment of the frame.

2

3 25. An apparatus according to either of claims 23 or
4 24, wherein the frame comprises at least one member
5 coupled to both of the swaging head and the stop plate.

6

7 26. An apparatus according to claim 25, wherein the
8 coupling between the member and at least one of the
9 stop plate and swaging head is capable of adjustment in
10 order to vary the length of the member between the
11 swaging head and the stop plate.

12

13 27. An apparatus according to either of claims 25 or
14 26, wherein the coupling between the member and the
15 stop plate comprises a screw thread engagement.

16

17 28. An apparatus according to any of claims 20 to 27,
18 wherein the stop plate comprises a bore and a device
19 for obturating the bore, such that when the device
20 obturates the bore, the device abuts the said other end
21 of the tubular, in use.

22

23 29. An apparatus according to claim 28, wherein the
24 device is removable from the stop plate such that a
25 tubular to be swaged may be passed through the bore of
26 the stop plate.

27

28 30. An apparatus for swaging an end of a tubular, the
29 apparatus comprising a swaging head for swaging the end
30 of the tubular, and a clamping device for clamping the
31 tubular, the clamping device being split into at least
32 three part-circular clamping segments which clamp
33 substantially around the outer circumference of a
34 portion of the tubular to permit it to be swaged.

35

36 31. An apparatus according to claim 30, wherein there

1 are at least four part-circular clamping segments which
2 clamp substantially around the outer circumference of
3 the tubular to permit it to be swaged.
4

5 32. An apparatus according to either of claims 30 or
6 31, wherein there are two clamping devices provided, a
7 forward clamping device which is arranged to be closest
8 to the swaging head, and a rear clamping device which
9 is arranged to be furthest from the swaging head.
10

11 33. An apparatus according to any of claims 30 to 32,
12 wherein the clamping segments are housed within a
13 clamping ring.
14

15 34. An apparatus according to claim 33, wherein the
16 clamping segments are mounted on the clamping ring in
17 an arrangement such that the segments can move with
18 respect to the ring.
19

20 35. An apparatus according to claim 34, wherein the
21 clamping segments can move only to a relatively small
22 degree with respect to the ring.
23

24 36. An apparatus according to any of claims 33 to 35,
25 wherein the clamping ring is split into at least two
26 part circular members.
27

28 37. An apparatus according to claim 36, wherein the
29 two part circular members are hinged together.
30

31 38. An apparatus according to claim 37, wherein the
32 two part circular members are hinged together such that
33 the ring is capable of being opened to permit a tubular
34 to be inserted into the ring, and closed to clamp the
35 segments around the tubular.
36

1 39. An apparatus according to any of claims 33 to 38,
2 wherein a range of segments can be housed within the
3 ring.

4
5 40. An apparatus according to claim 39, wherein the
6 range of segments is of varying radial thickness, to
7 permit a range of differing diameter tubulars to be
8 clamped.

9
10 41. An apparatus for swaging a tubular, the apparatus
11 comprising a swaging head for swaging the end of the
12 tubular, and a clamping device for clamping the
13 tubular, the clamping device having a plurality of
14 teeth for gripping the outer surface of the tubular,
15 and a plurality of grooves formed between the teeth,
16 wherein the gripping surface of each tooth is
17 substantially parallel to the longitudinal axis of the
18 tubular to be gripped.

19
20 42. An apparatus according to claim 41, wherein the
21 grooves are formed with two side walls which are
22 substantially perpendicular to the longitudinal axis of
23 the tubular to be gripped.

24
25 43. An apparatus according to claim 42, wherein the
26 grooves are formed with a lowermost surface which is
27 substantially parallel to the longitudinal axis of the
28 tubular to be gripped.

29
30 44. A clamping device for use with the apparatus of
31 claim 41, the clamping device comprising a plurality of
32 teeth for gripping the outer surface of a tubular, and
33 a plurality of grooves formed between the teeth;
34 wherein the gripping surface of each tooth is
35 substantially parallel to the longitudinal axis of the
36 tubular to be gripped.

1 / 15

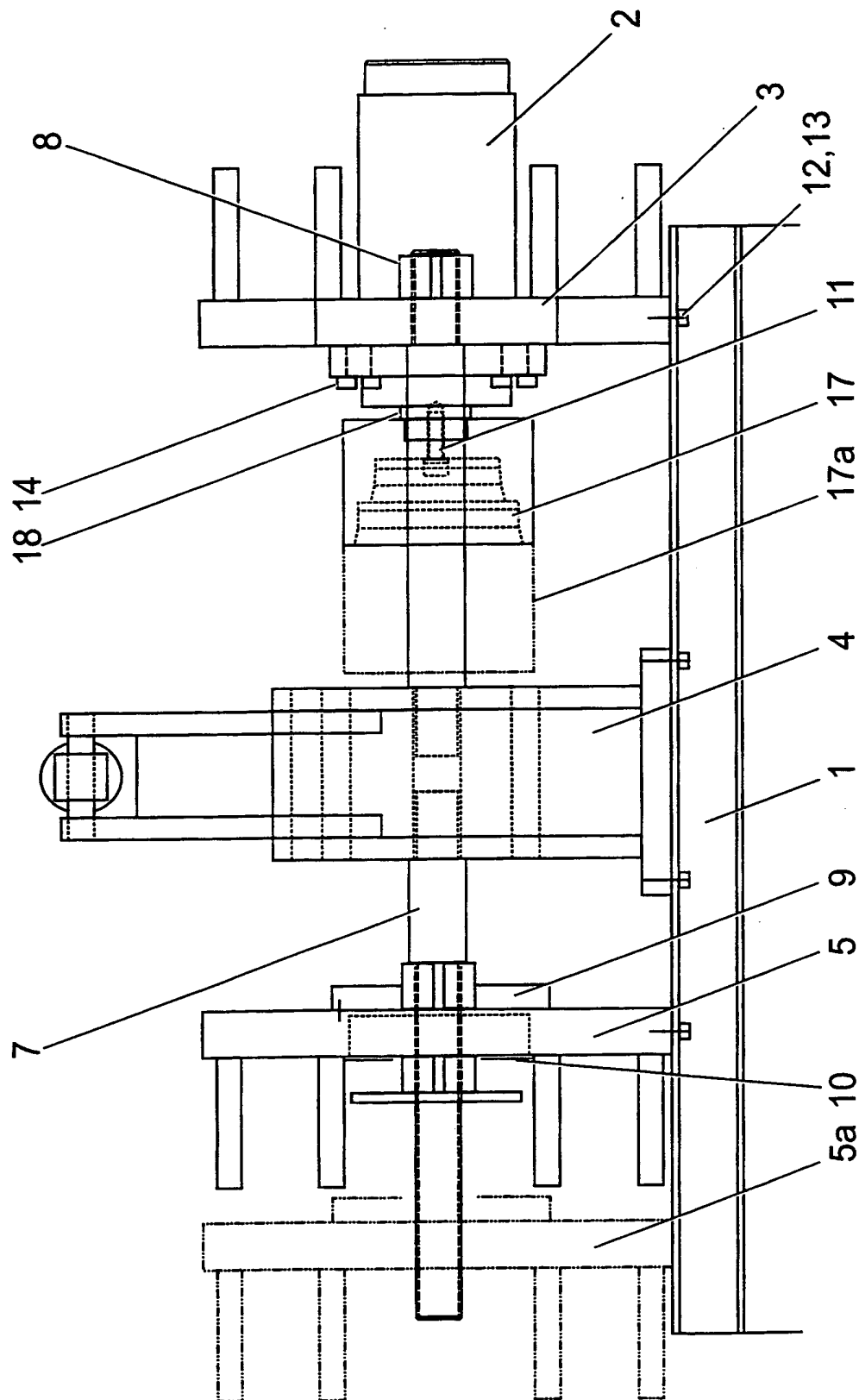
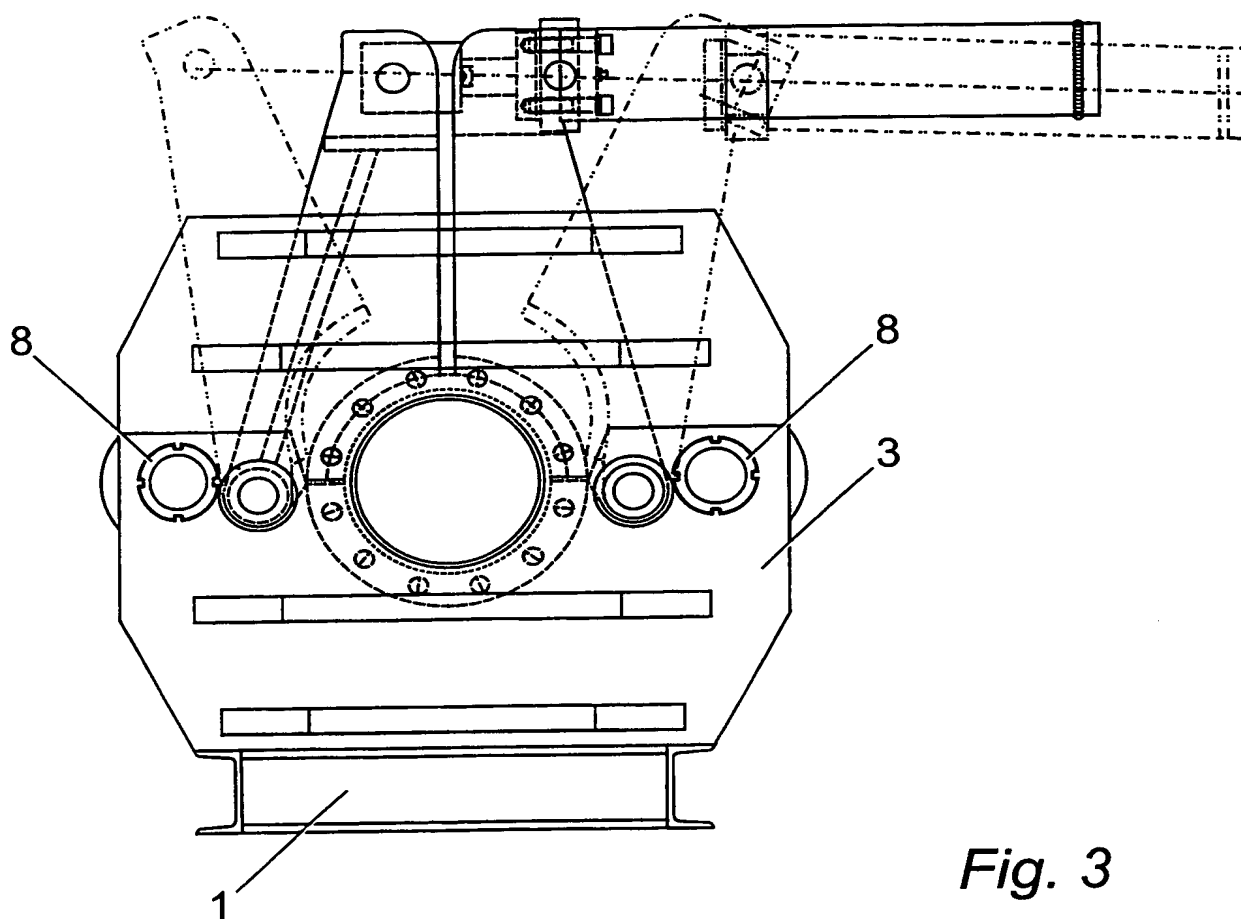


Fig. 1

3 / 15

*Fig. 3*

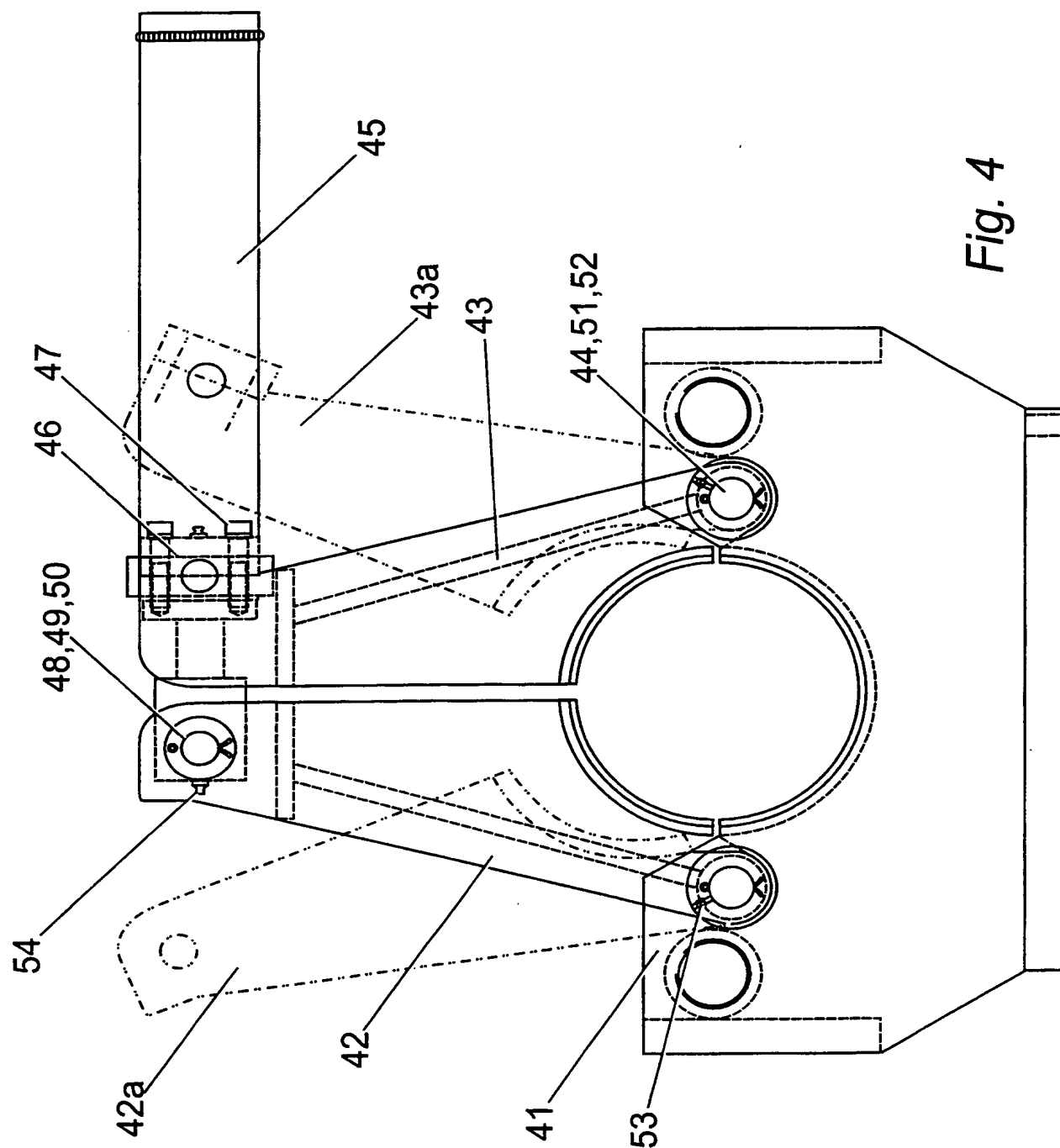


Fig. 4

5 / 15

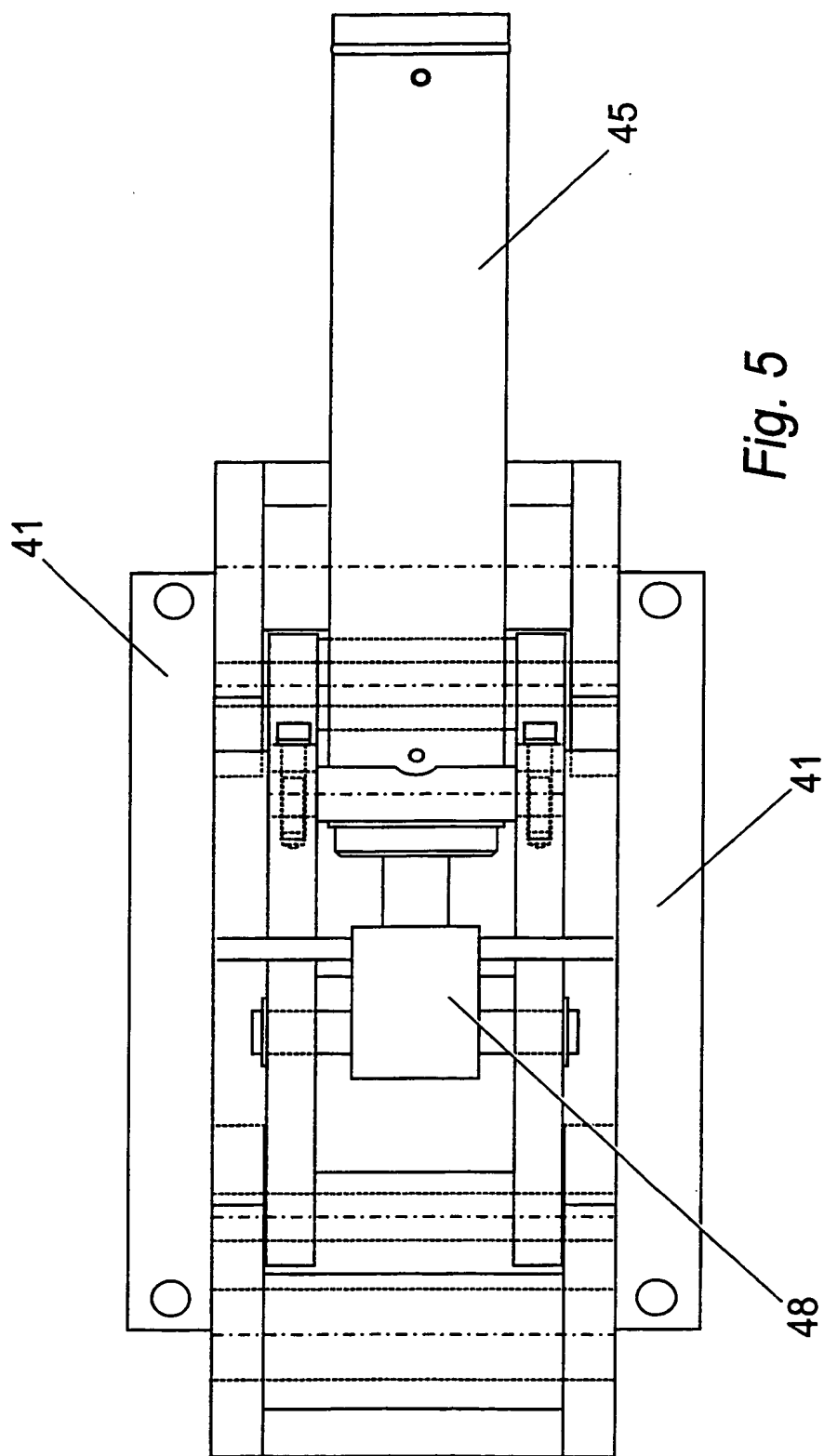
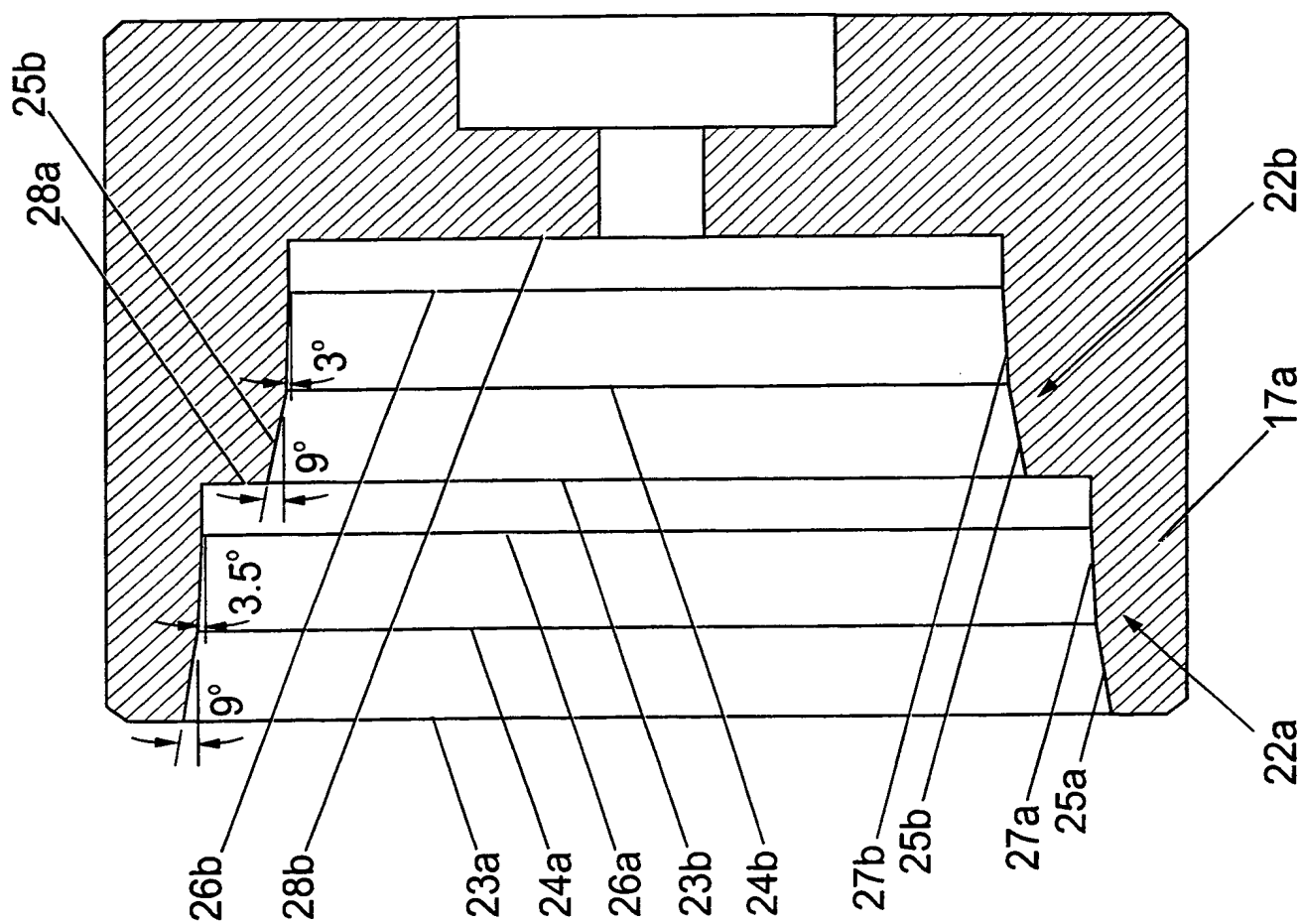
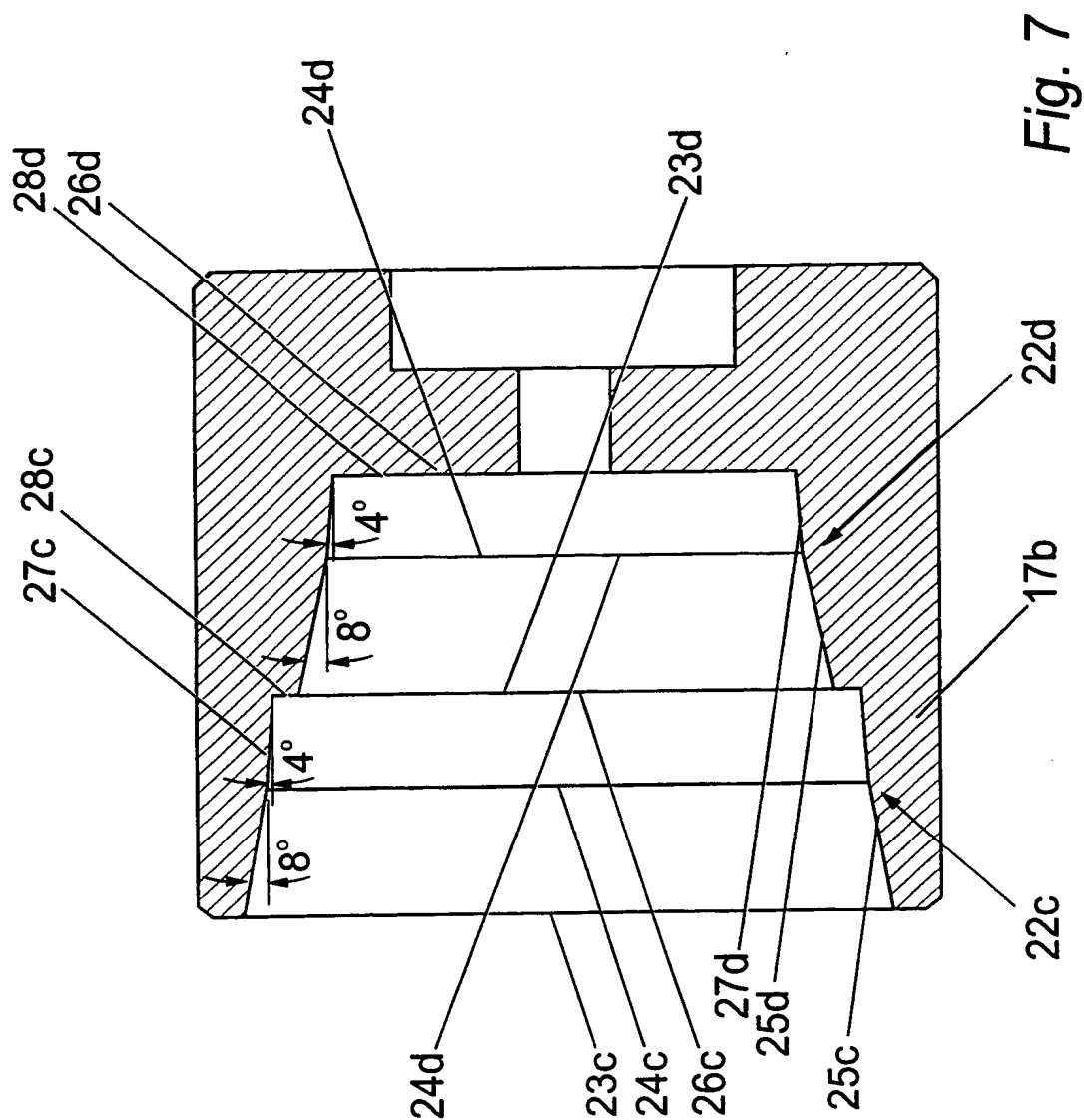
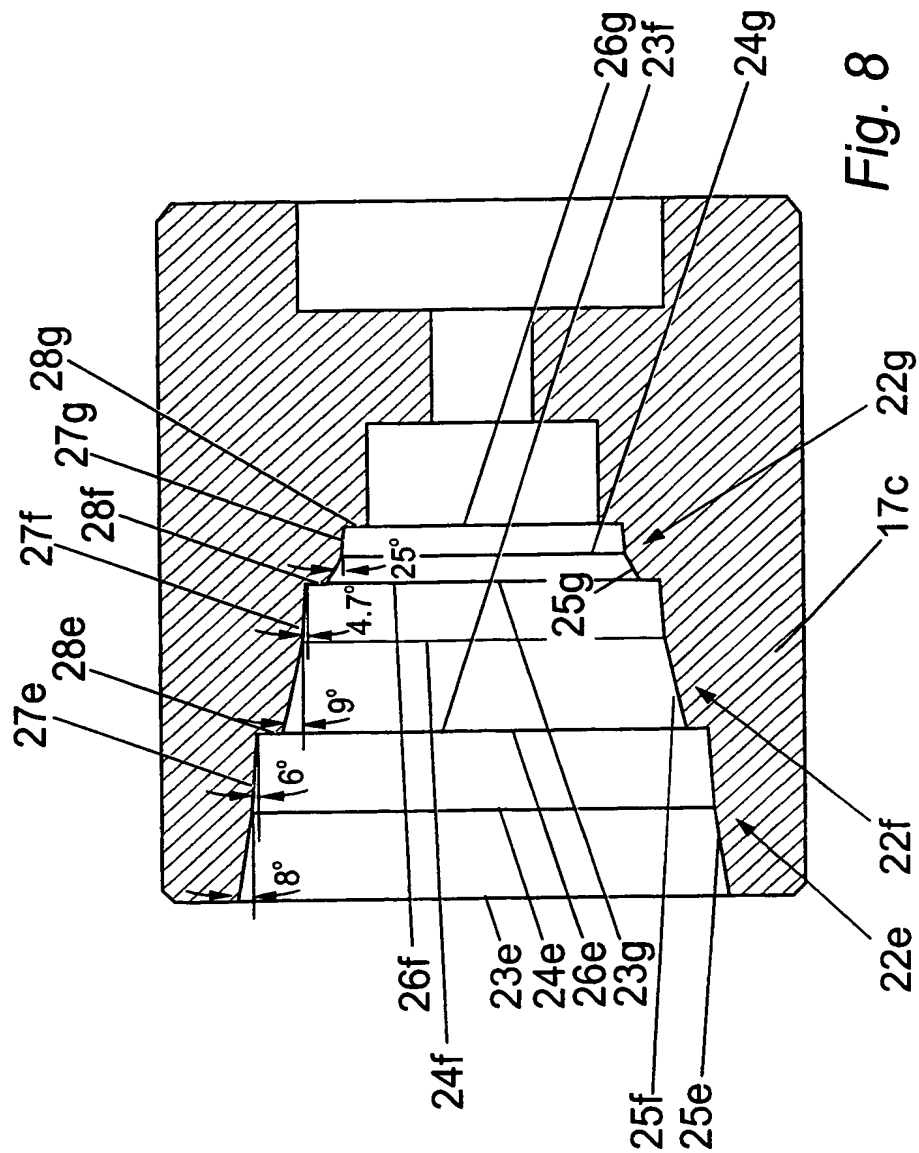


Fig. 6





SUBSTITUTE SHEET (RULE 26)



9 / 15

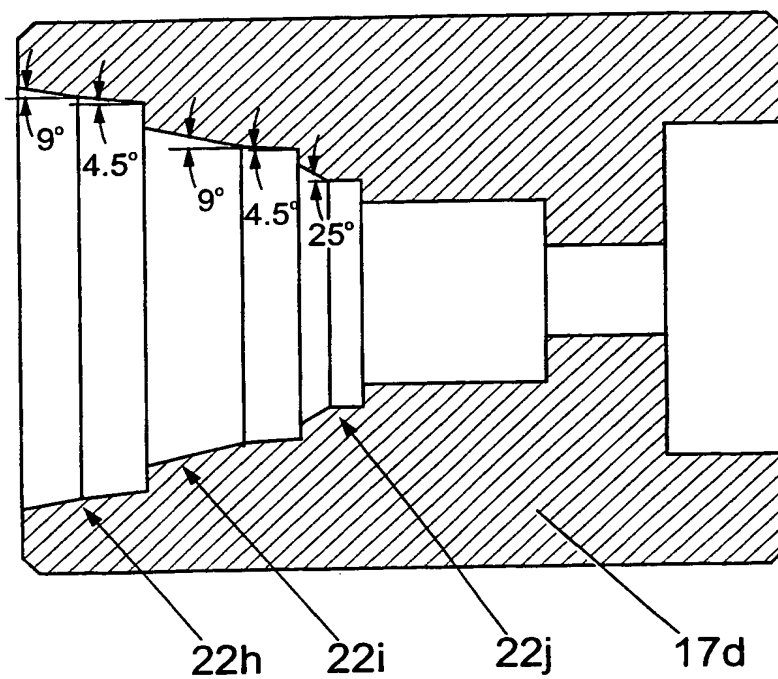
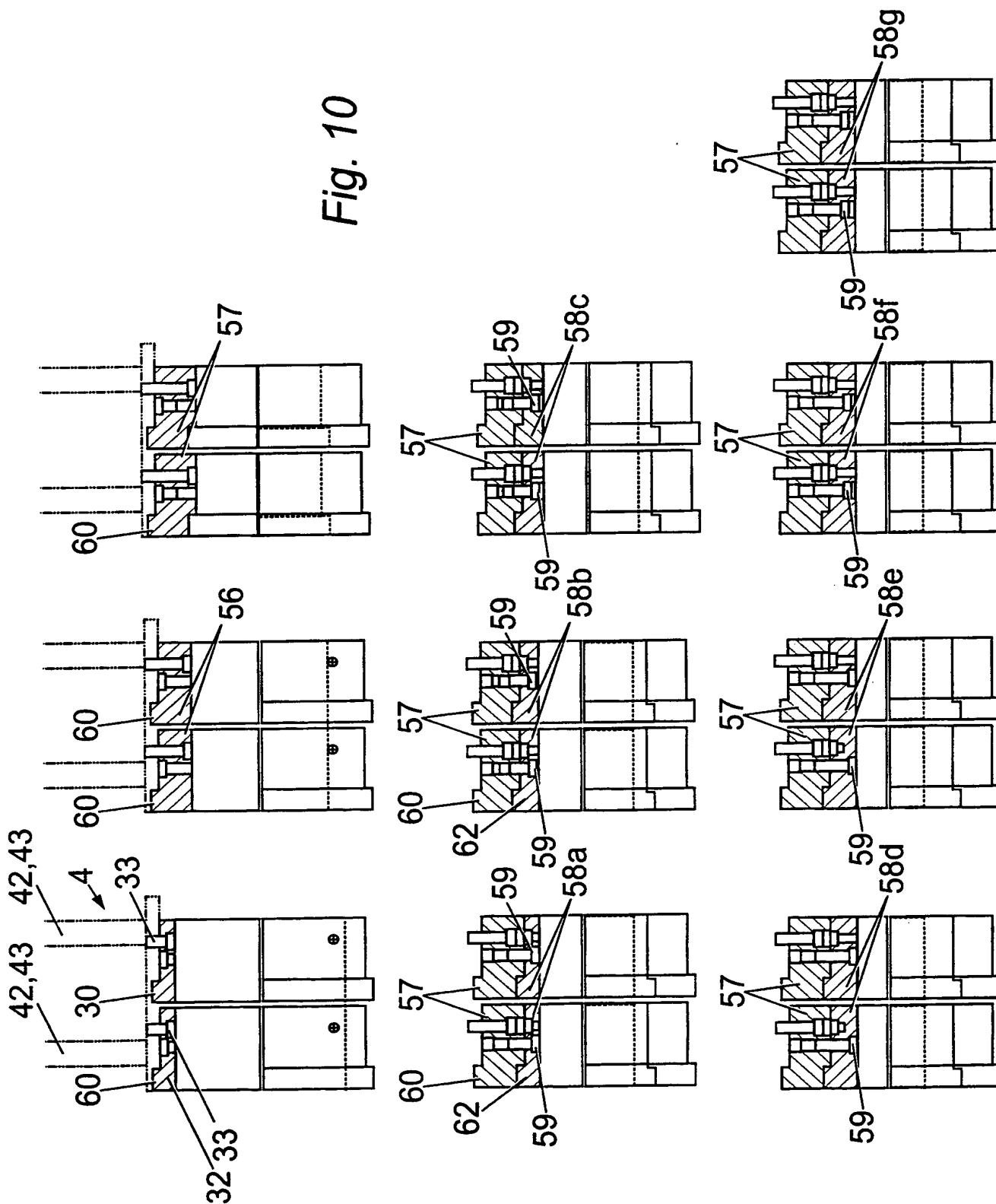
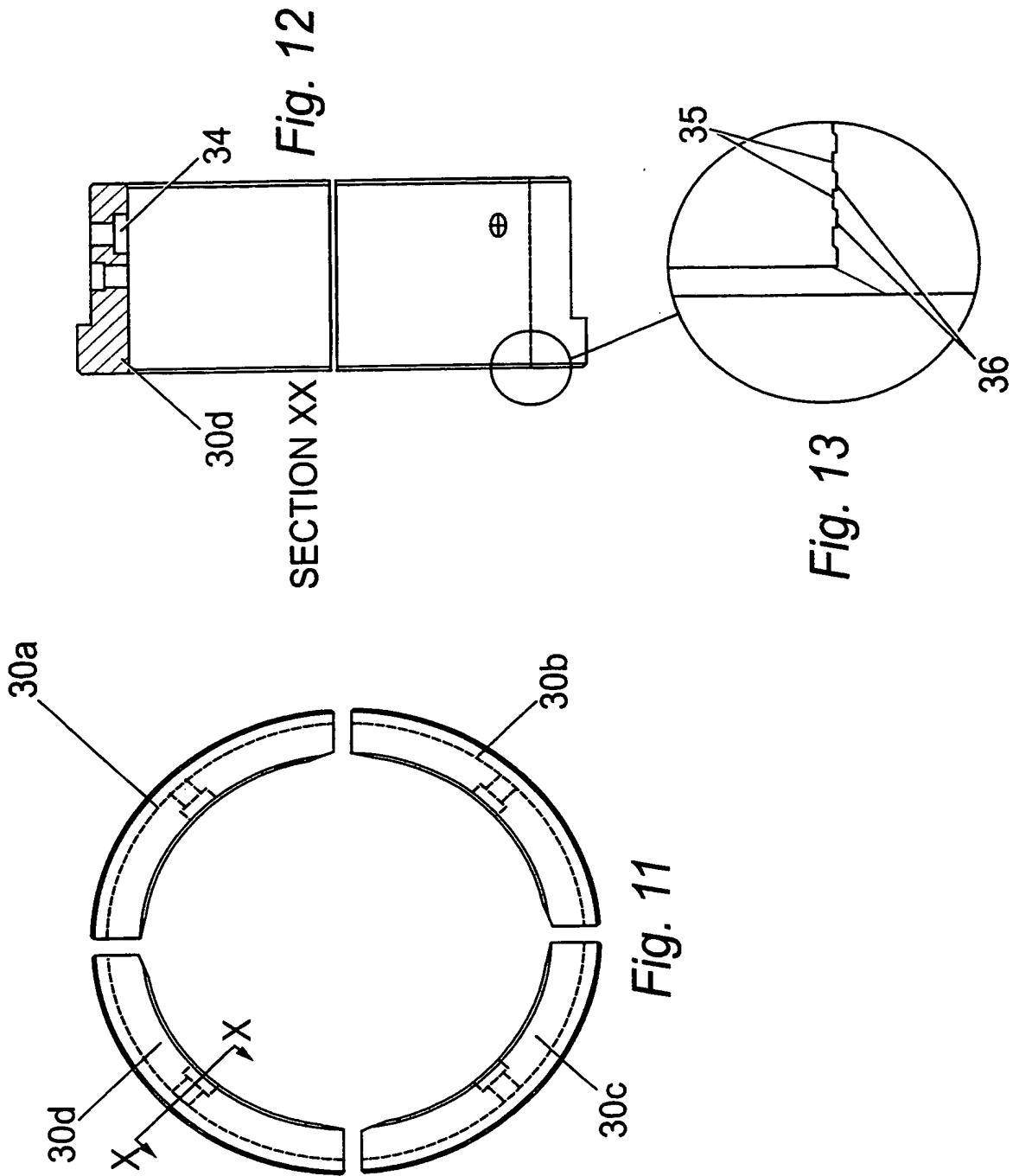
*Fig. 9*

Fig. 10





12 / 15

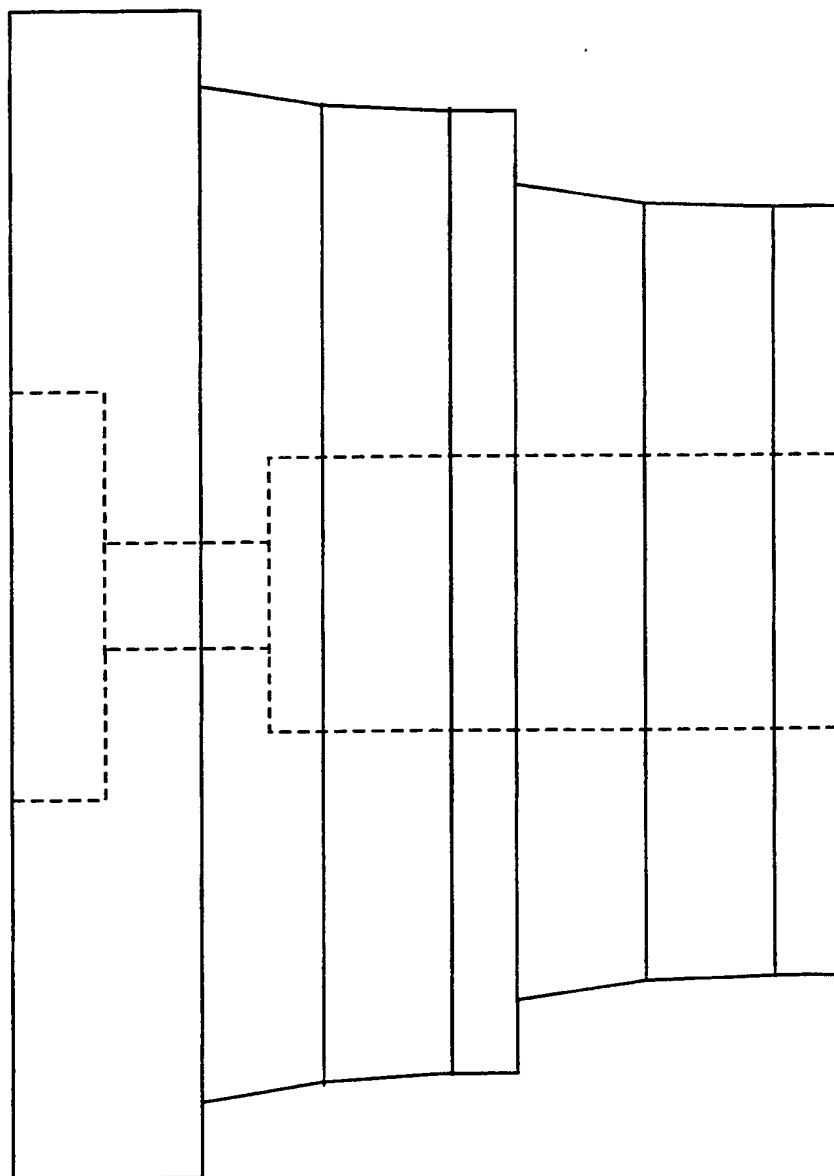


Fig. 14

13 / 15

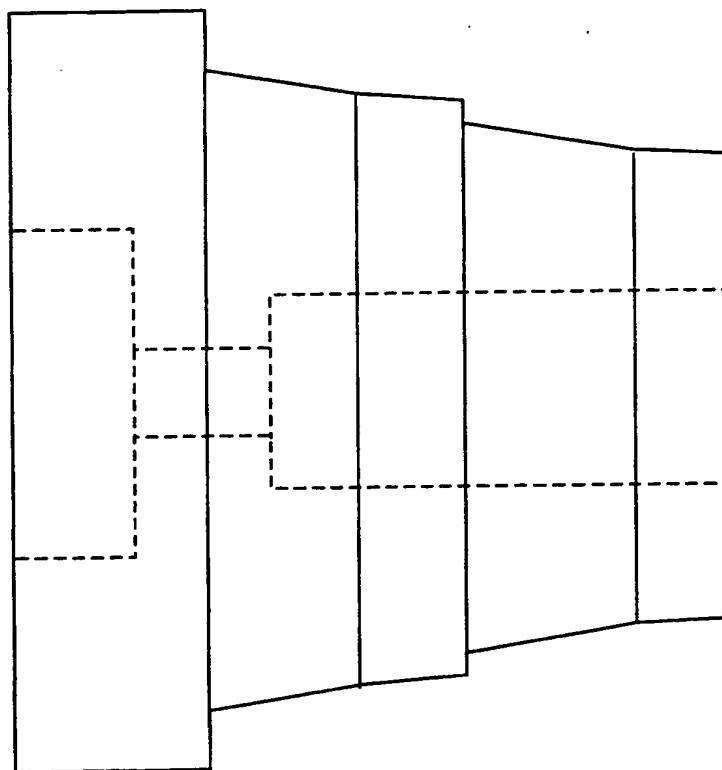


Fig. 15

14 / 15

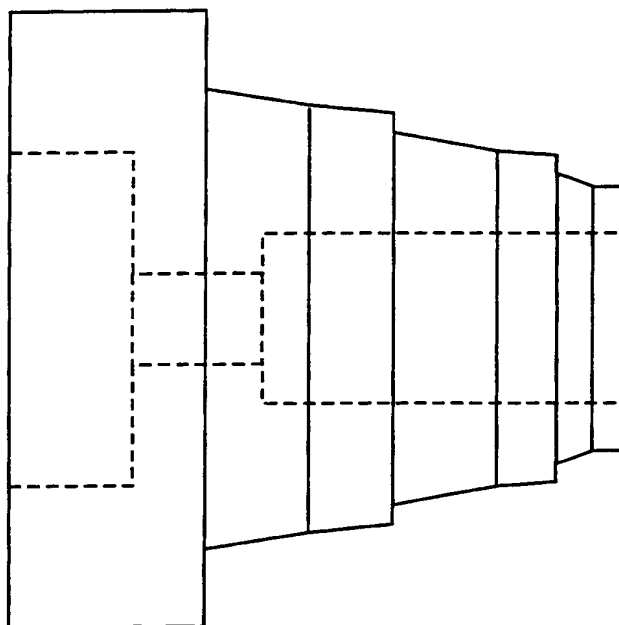


Fig. 16

15 / 15

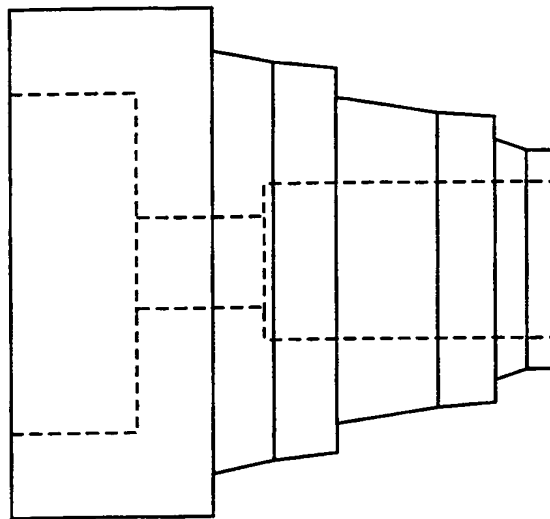


Fig. 17